# A CHAPTER ON CHOLERA FOR LAY READERS

BY
WALTER VOUGHT Ph.B., M.D.

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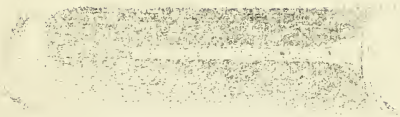

# PLATE I.

FIG. 1.—CHOLERA CULTURE TWO DAYS OLD.

FIG. 2.—CULTURE OF FINKLER-PRIOR BACILLI TWO DAYS OLD.

FIG. 3.—CHOLERA CULTURE FOUR DAYS OLD.

FIG. 4.—CULTURE OF FINKLER-PRIOR BACILLI FOUR DAYS OLD.

# A CHAPTER

ON

# CHOLERA

## FOR LAY READERS.

HISTORY, SYMPTOMS, PREVENTION,
AND TREATMENT OF THE DISEASE.

BY

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# PREFACE.

This little work is offered to the public with the hope that it will enable the reader to obtain a clear and comprehensive idea of a disease which, at present, there is every reason to believe will appear this summer in our own country.

That cholera is one of the few germ-diseases which, by the use of care and intelligence, can be easily prevented, if proper measures are taken *beforehand* to provide that the conditions necessary for its development are abolished, is the firm belief of all sanitarians. And it is a belief founded upon scientific facts which have never yet been shaken by their most zealous opponents.

In a work of this size it is impossible to give all references of the many authors

consulted. It is believed that every statement made has been corroborated.

The author desires to express his obligation to Dr. S. T. Armstrong, Chairman of the Section of Public Health of the New York Academy of Medicine, for his assistance in the preparation of the chapters on the history of cholera, quarantine, and of the handling of the disease on shipboard.

12 West Tenth Street,
New York City.

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# A CHAPTER ON CHOLERA FOR LAY READERS.

## DEFINITION.

Cholera is an infectious disease, caused by a specific micro-organism, characterized by certain symptoms, running a certain course, and terminating either in death or recovery.

It is endemic in certain parts of Asia, and, at intervals, becomes epidemic.

One attack protects against others; but this protection is relatively limited in time, lasting, it is believed, not over four years.

# HISTORY OF CHOLERA.

THE time and place of origin of many of the diseases that are commonly referred to as contagious or infectious are veiled in obscurity, the history of medicine ascribing the origin of such a disease to the period when the first comprehensive description thereof was published. Later research has often shown that the particular disease in question had been more or less clearly described at some period preceding that usually accepted as the date of its first appearance.

All authorities agree that cholera originated in India, though many writers have believed that it is a comparatively recent disease in that country.

Mr. George Gaskoin, in an interesting review (*Medico-Chirurgical Review*, vol. xl, p. 217) of the literature of cholera, states that the word "murree," derived from the primitive

dialects of India, indicated the disease that is known to us as Asiatic cholera. The word, though adopted by the Brahmins, and occurring in theological writings that are older than the Brahminical Shaster, is not of Sanscrit origin, and it apparently originally signified "the Death."

At Viziannugger there is, engraven on a monolith placed before the site of an ancient temple, the following description of murree: There are "blue lips, a shrunken face and hollow eyes, a knotted belly, with limbs cramped and curled as if by fire, breath clinging to the warrior's face; fingers that are probed, snaky, and clawed; and in writhings the patient expires, the victim of Siva." This inscription is referred by antiquarians to a period more than a century before the invasion of India by Alexander; in it there is a further reference to a belief that cholera is invoked by magic, which seems to show that the disease was known in that country, at an early date, to be contagious; or, at least, that it was likely to spread where

many persons were living in close proximity, as in camps.

Later, Garcia d'Orto, in 1563; Bontius, in 1638; Paisley, in 1774; Girdlestone, in 1787, and Curtis, in 1807, wrote descriptions of the disease. But the first general epidemic, or pandemic, by which the attention of mankind was directed to the existence of such a thing as cholera was, we are informed by Hirsch, that of 1817 to 1823. During those years it prevailed generally in India, extended eastward to China and Japan, westward to the coast of Syria, and northward to Australia, coming close to the borders of Europe, but not crossing them.

*The second pandemic* commenced in Bengal, in 1826; traversed the northwest provinces of India; followed the caravan routes to Cabul, Balkh, Bokhara, and Khiva. It extended over Persia, reached Orenburg in Russia in 1829, and in the following year it was generally prevalent in that country. From Russia it was transported to Germany, France, England, the Scandinavian peninsula, all of Southern Europe,

and eventually was carried to North and Central America.

*The third pandemic* began in 1846, extending over Persia, attaining its maximum in Europe and in the United States in 1848–1850. There was a slight remission from 1850 to 1852 in Europe, but it started anew in the latter year and prevailed more or less extensively throughout the civilized world until 1863. Hirsch has called attention to the fact that the evidence seemed to attest a continuous reproduction of the poison in extra-Indian countries, and that the power of reproduction was exhausted only after the lapse of more than ten years.

*The fourth pandemic* began in 1863, rapidly extending to the sea-coast of Arabia, and in a few weeks overrunning a large part of Southern Europe.

*The fifth pandemic.* While Hirsch believed that the pandemic of 1871 was due to a reawakening of the seeds of the disease sown in 1863, the fact that it commenced about the shores of the Black Sea affords strong circum-

stantial evidence that it may be regarded as the fifth pandemic, spreading through Europe and reaching America.

*The sixth pandemic* started in Egypt in 1883, ravaged Southern Europe, and was carried to South America.

*The seventh pandemic* commenced in Persia in 1891, was carried to Russia in 1892, and extended thence to several localities in Europe.

The history of the epidemic manifestations of cholera outside of India shows that there are three routes by which it has been carried northward and westward into Asia Minor and Europe.

1. It has traversed India to the northwest provinces, it has then crossed the Khyber Pass on the north or the Bolan Pass on the west into Afghanistan, and traveled onward to Cabul and to Herat; thence it has followed the caravan route through Balkh, Bokhara, Khiva, and the country of the Kirghis into Russia.

2. It has spread from Southern India up the Gulf of Persia, traveling northward to Syria and Egypt and northwestward across Persia to the

Caspian Sea, and thence along the western shore to the Volga, and up that river into Russia.

3. It has been transported to the Red Sea, and thence to the countries bordering on the Mediterranean. By means of vessels it has been carried eastward to China and Japan, and one epidemic in America was introduced from Jamaica, whence the disease was carried directly from India.

The large fairs that are held annually in several places in the latter country are attended by merchants and traders from all parts of India, and it may be easily understood how it is possible for the healthy to be infected by those coming from localities where the disease is prevailing, and for these infected traders crossing the Himalayas to sow the seed of the pestilence as they travel.

The annual pilgrimage of the Mohammedans of India to Mecca is another medium for the distribution of cholera throughout Mohammedan countries, notwithstanding the opinion expressed by various Anglo-Indian writers, that

the pilgrim steamers from India have rarely been the medium for the transmission of the disease.

The picturesque description given by Eugene Sue in the "Wandering Jew," in which he refers to the progress of an epidemic of cholera being at the rate of the distance a man can journey in a day, may be here recalled as a fact that was true in that day, and is in this, wherever pedestrianism, the horse, or the camel are the sole method of travel. But these have been supplanted and are not now generally in vogue, and the frequent and rapid communications existing between India and the Mediterranean coast by means of the Suez Canal, as well as those between Northern India and Russia by means of the railroads, the caravans, and particularly the Caspian Sea steamers and the Trans-Caucasian Railway, make the introduction of the disease into Europe but a matter of a short time; as it permanently exists in that country and constantly menaces the world.

From the statistics contained in the reports

of the Sanitary Commissioners with the government of India, it may be learned that the total mortality from cholera in the population of India was 208,371 in 1886, 488,788 in 1887, 270,408 in 1888, 428,923 in 1889, and 297,443 in 1890.

It seems excessive, even when we take into consideration the enormous populations and their racial characteristics, that in five years more than a million and a half of people should die of a preventable disease. The government of that country admits that what has been done in the direction of sanitary reform may appear small in comparison with what remains to be done, but it pleads the ignorance of the masses, their dislike of any change of custom, the lack of sufficient executive agencies, the want of necessary funds, as mitigating circumstances that serve to condone its delinquency. The latter is the more flagrant, in view of the capable and distinguished professional advisers it has had during the past thirty years.

While India's responsibility for past pandemics of cholera is, possibly, diminished by the then-existing ignorance of the causation of cholera, and the means by which the causative principle was transmitted, our present knowledge shows that that country is as responsible for cholera as are Central America, Cuba, and Brazil for yellow-fever epidemics. However indifferent we may feel to the annual sacrifice of several hundreds of thousands of natives of India; however much we may satisfy ourselves that it is but the application of the theory of the extermination of the unfit and the survival of the fit, we cannot remain indifferent or satisfied when we contemplate the fact that evasion of the responsibility of being our brother's keeper reacts upon ourselves, by perpetuating a disease that may, at any time, invade the countries of the western nations.

# CHOLERA IN AMERICA.

The records of the first appearance of cholera in America are not very satisfactory. Present research has shown that vessels on which cholera deaths had occurred arrived at the Grosse Isle Quarantine Station, on the Saint Lawrence River, in April, May, and June of 1832. The disease spread along the Saint Lawrence, and appeared, about the middle of June, in the northern part of New York State, and was also introduced independently through the New York City Quarantine Station. The disease was carried by the emigrants along the Great Lakes, the Ohio and Mississippi Rivers, appearing in most of the United States. On account of the scarcity of records, it is impossible to state how extensive the ravages of the disease were.

The pandemic of 1833 pursued a course directly opposite to that of 1832, for the cholera

became epidemic in Cuba in February, 1832, and was carried from there to New Orleans, thence following the line of travel along the Mississippi and Ohio Rivers, and affecting the cities along their banks.

In 1834 Asiatic cholera once more passed through the Saint Lawrence quarantine in the first week in July, and from this source the United States was again infected. But Dr. C. A. Lee, in an account of the cholera in New York City in 1834, states that sporadic cases occurred during the winter and spring of that year, and about July 1st bowel complaint began to prevail extensively, although the board of health did not report the existence of cholera until August 9th, when it was stated that there had been fourteen deaths from the disease since July 23d. In this year, also, there must have been a local as well as a Canadian origin for the disease, and one that entered through the quarantine; for cholera had not remained latent since 1832, and New York City did not suffer from the epidemic of 1833 that

affected particularly the Ohio and Mississippi Valleys. In this year New Jersey, Pennsylvania, Maryland, the District of Columbia, Virginia, Georgia, Florida, and Texas upon the sea-coast, and Ohio, Michigan, Kentucky, Tennessee, and Mississippi in the interior, became infected with the disease.

The cholera epidemic of 1835 was less extensively distributed, being introduced through New Orleans and Charleston from Cuba.

The epidemic of 1849 had two sources: New York and New Orleans. In the case of the first city, we learn from Dr. Sterling's history of cholera at Staten Island quarantine, that a cholera-infected ship arrived at that station on December 1, 1848. The well steerage passengers were transferred to a detention building, excepting one passenger, who, for some unexplained reason, was permitted to come to the city of New York. Eleven cholera patients were sent to the quarantine hospital, and subsequently sixty cholera patients were transferred to it from the immigrants under observation in

the detention building. Patients in the general wards were infected in consequence of these patients being placed among them. The author ingenuously states that cholera did not overleap the barriers of the quarantine inclosure, though more than one hundred immigrants scaled the walls and fled to New York City; neither, he states, did the numerous visitors receive or convey it.

Such an administration was sure to bring disaster, and Dr. W. P. Buel, in his remarks on the epidemic of 1849, states that there were deaths from cholera in New York City, during the winter of 1848–49, of immigrants *who broke quarantine.* Dr. Sterling states that the disease re-appeared at quarantine in April, and Dr. Buel that the first cases in New York City appeared on May 11th, though the attending physician did not report his suspicions regarding their character to the board of health until the 14th; and when Dr. Buel visited the house, on the 16th, he found a "second crop" of five cholera cases, the first patient having died.

An idea of the great difficulty of obtaining statistics regarding these several epidemics may be obtained from the report of the Sanitary Committee of the New York Board of Health on cholera as it appeared in that city in 1849. From the appearance of the disease until October 13th, when the epidemic was at an end, the mortality (15,219) was double that of the preceding year, though only a third of the deaths were reported as due to cholera; but that that disease was probably reported in other ways is shown by the facts that, during the period mentioned, the mortality from bowel complaints was more than 400 per cent. greater than during the preceding year, that from cholera infantum and from dysentery was doubled, that from cholera morbus was 900 per cent. greater, and that from diarrhœa almost 200 per cent. greater.

In December, 1848, several cholera-infected vessels arrived at New Orleans; the disease broke out in that city and was carried up the Mississippi and Ohio Rivers, and in the summer of 1849 cholera was pandemic.

In 1850 cholera existed at many localities on the Mississippi, Missouri, and Ohio Rivers, partly in consequence of the pandemic of the preceding year, partly in consequence of the arrival at New Orleans of cholera-infected vessels, passengers from which proceeded to various points along these rivers.

In 1852 cholera appeared at several places in Ohio, in Illinois, Wisconsin, and Missouri, being introduced by immigrants coming through New York and New Orleans.

During the winter and spring of 1853–54, a number of ships, on which cholera deaths occurred, arrived at the port of New York; but the disease first appeared in epidemic form in some recently-arrived immigrants in Chicago, in the latter part of April, 1854. Subsequently, cholera appeared at various places on the Mississippi, Missouri, and Ohio Rivers, and eventually in New York, Pennsylvania, Maryland, and, in fact, in all the States to which infected immigrants went.

The United States remained free from any

visitation of cholera until November, 1865, when several infected vessels arrived at the New York City quarantine. The first cholera-infected vessel to arrive in 1866 was a steamship, on April 18th, and quite a number of infected vessels arrived subsequently. The disease appeared in the city on May 2d, principally affecting newly-arrived immigrants. In some way cholera was introduced among the recruits of the army stationed on Governor's Island, in New York Harbor. The excellent report of Assistant Surgeon J. J. Woodward, published in the report on the "Cholera Epidemic in the United States in 1873," from which volume we have obtained many of these facts, shows the distribution of cholera throughout the United States by the movement of army recruits. But the immigration that entered the country through the various ports did much more than the army to diffuse the disease in the Western and Southern States.

The epidemic of 1873 was introduced into the United States from Jamaica, or from Ger-

man ports, or both, by way of New Orleans. It ascended the Mississippi and Ohio Rivers, was carried into the States adjoining Louisiana, and was not exterminated until the fall.

While cholera-infected vessels arrived at the port of New York in 1887, during the prevalence of the disease in Southern Europe, no cases occurred outside of the quarantine station.

The epidemic of 1892 pursued, as has been stated heretofore, the usual course through Persia and Russia, later infecting certain cities in Germany and France. Cholera-infected vessels then arrived at the port of New York, and a few cases occurred in New York City, the origin of which was veiled in obscurity. But the effective administration of the New York quarantine prevented the introduction of the disease into this country; nor was there any evidence showing any relationship between the cases that occurred in the city and the patients in the hospitals at quarantine.

The experience of this country has demon-

strated the possibility of the exclusion of cholera by efficient quarantine administration. The existing system of consular notification of the prevalence of cholera in any European or Asiatic port or country warns our health-officers of the existence of the danger, and enables them to exercise additional care in scrutinizing immigrants from such countries.

## CAUSES OF THE DISEASE.

THE specific cause of cholera is a small micro-organism, or germ, known to scientists as the "comma bacillus," or, as it is also called, the "cholera spirillum." This minute germ was discovered by Prof. Robt. Koch, of Berlin, in 1883. An epidemic of cholera was threatening to invade Europe at that time, and the German government equipped a scientific expedition to proceed to India to investigate and ascertain the cause of the disease. As the result of this expedition, Prof. Koch, who had been placed at its head, soon reported that he had discovered the cause to be what he called the "comma bacillus," and that this microbe was present in the discharges of patients suffering from the disease, and in the intestinal contents after death.

The "comma bacillus" has never been found in a healthy person, and has never

been found in any other disease, and there is every evidence to prove that it can always be found in the discharges of those affected with cholera, and, soon after death, in the bodies of persons dying from the disease. The bacilli are found in the intestinal walls, but in no other organs of the body. They are not found in the blood, and are usually absent from the vomited matter. Experiments which were made with the object of producing the disease in animals were, at first, unsuccessful or unsatisfactory. It was known that animals were never attacked by cholera, they being immune against it, *i.e.*, incapable of contracting it. Doubt has been thrown upon this latter statement of late, for an observer in Japan has observed a dog who died with the symptoms of cholera, and post-mortem investigation and bacteriological examination showed that the disease was true cholera.

Koch, however, finally succeeded in producing the disease in guinea-pigs, by first neutralizing the acid of the gastric juice and

then introducing a pure culture of the bacilli into the stomach, and, to permit of sufficient length of time to elapse for the beginning of a growth of the bacilli in the intestines, the animal was narcotized by an injection of opium, thereby temporarily paralyzing the muscular walls of the intestine. The narcotic effect of the opium soon passes away, and the animal resumes its normal condition. Soon, however, it begins to show signs of discomfort, refuses food, and there develops a weakness of the hinder extremities, and the breathing becomes decreased in frequency, and labored; after forty-eight hours the animal usually dies, and examination of the intestines shows them to be filled with a watery fluid containing a large number of the cholera bacilli. The lining membrane of the intestines shows an abnormally reddish color, and their walls infiltrated with bacilli the same as in man.

There are certain symptoms lacking in the disease thus produced in animals which are

characteristic of the disease in man, namely, there are present no vomiting or purging; but this fact is explained when it is considered that guinea-pigs do not vomit, and a portion of their intestines is of such extraordinary size that it is capable of containing a very large amount of watery fluid before it is passed.

Experiments, in man, have occurred during the past year, which throw light upon this subject, although not undertaken with this idea in view. Two German observers, both of them celebrated men, who have held the opinion that the bacilli were not the cause of the disease, with the courage of their conviction swallowed certain amounts of bouillon culture mixed with soda solution (to neutralize the gastric juice). Both were attacked with choleraic symptoms, of a mild type in one case, severe in the other; in the dejecta of both large numbers of bacilli were found. They both recovered.

One of the attendants on the bacteriological course in Koch's laboratory accidentally infected

himself, and all the symptoms of cholera were present, together with the bacilli in the stools. No cases of the disease had occurred at the time in Berlin, and no other means of infection other than the bacilli of the laboratory cultures was found to be possible.

### Morphological Characters of the Germ.

The bacilli have the form of slightly-curved rods (hence the name "comma bacillus") with slightly-rounded ends (see illustration), and measure from .000031 to .000078 inch in length and from .000011 to .000015 inch in breadth. These small rods are often seen to be joined end to end, when they have the form of the letter **S**. In older growths on nutrient culture media or fluids they are seen to have a spiral shape (hence the name "cholera spirillum"), and, under certain circumstances, the single rods and spirilla possess a lively motion. In suitable nutrient media they grow in certain characteristic ways, which serve to distinguish them from all other disease germs. When

they are planted on *gelatin plates*, and these are kept at a temperature of 22° C. (72° F.) in a suitable oven, after a lapse of twenty-four hours there is seen, with the naked eye,

COVER-GLASS PREPARATION CHOLERA BACILLI. GELATIN CULTURE, TWO DAYS OLD. Magnified 1000 × (Fraenkel and Pfeiffer).

in the depth of the gelatin, small, white dots. As the growth continues the gelatin has the appearance of being filled with many small, funnel-shaped air-holes, at the bottoms of which are to be seen the growing colonies as

small, white masses. Around the growing colonies the gelatin becomes liquefied. When examined under the microscope, the colonies growing on the gelatin plate present a peculiar characteristic appearance. They are of a bright-white or pale-yellow color, of an irregular, rounded shape, with uneven, irregular margins. As the colonies grow they assume an uneven, granular appearance, and look as if they were composed of minute particles of glass or crystals. At the same time, they often present a delicate, reddish tinge found in no other bacterial growth.

*In Gelatin Tubes.*—When a test-tube containing gelatin is inoculated by means of a platinum needle, upon which are some of the cholera bacilli, a growth takes place along the entire line of the inoculation. Liquefaction occurs slowly, and begins at the top of the inoculation, where a short, funnel-shaped mass is soon formed, the upper part of which contains air, and below the bacteria are seen growing as a whitish mass. The funnel in-

creases, later, in depth and breadth; the lower part of the inoculation appears as a thin, glistening thread.

About the fifth or sixth day, the bacteria which have developed have descended into the lower third of the original line of inoculation, and here are seen as yellowish, white, loosely-curled masses (see Frontispiece, Plate I). As the growth continues the gelatin liquefies more and more, the upper part becomes turbid, the bacilli settles to the bottom, and the surface of the liquefied gelatin becomes covered with a whitish film. This film also contains bacilli.

After eight weeks the gelatin in the tubes becomes completely liquefied, and the bacilli are, at the time, incapable of further reproduction. The bacilli may also be grown in bouillon and on agar-agar (a material derived from a sea-weed, which, in aqueous solutions, remains solid above the temperature of the body), and on the cut surface of potatoes. They may be stained by certain aniline dyes, best with an aqueous solution of fuchsin, when

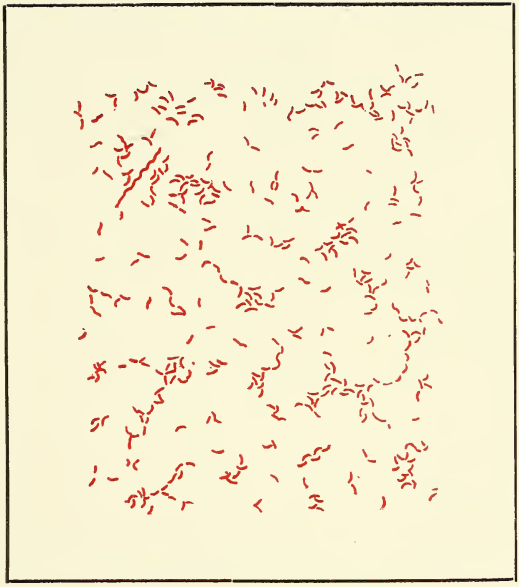
they appear under the microscope as minute, bright-red, curved rods (see Plate II).

### Viability of the Germ.

Its viability is very slight. It is quickly destroyed by acids, even in extremely dilute solutions, and it flourishes best in slightly-alkaline nutrient media. Experiments have shown that, in milk or water containing other bacteria, it soon dies out; but it must be borne in mind that in nature it seems to possess the power to live and multiply for a very long period of time in these substances. It grows rapidly when introduced into sterilized milk, *i.e.*, milk in which all germs have been previously killed.

The bacilli grow at the ordinary temperature of the room, but not below 14° C. (57° F.) or above 42° C. (108° F.). Low temperatures retard their growth, but do not destroy them; they even endure a temperature of –10° C. (14° F.) without destruction, but are destroyed by a temperature of 55.6° C. (132° F.).

# PLATE II.



Cover-Glass Preparation of Cholera Bacilli from a Bouillon Culture, Stained with Fuchsin. Magnified × 500. (Riedel.)

Direct sunlight has the power of retarding the growth of various bacteria, and exposure to the sunlight for five hours is sufficient to destroy the vitality of the cholera bacilli. In

CHOLERA-BACILLI CULTURE ON STARCHED LINEN, TWENTY-FOUR HOURS OLD; COVER-GLASS PREPARATION. Magnified 1000 × (Fraenkel and Pfeiffer).

a dry temperature of 80° C. (176° F.) they perish in a few moments. Drying quickly destroys them; but when moist, they retain their vitality for months. On moist surfaces, such as moist linen or clothing (see illustra-

tion), they multiply rapidly, and retain their vitality for long periods if on soiled and damp garments. If they be mixed with the ordinary bacteria of putrefaction they soon die out, and if mixed with healthy discharges from the bowels only live a few days.

Experiments have been made to determine the viability of the bacilli upon different food-stuffs, and various other substances used by human beings. Thus it was found that, at the ordinary temperature of the room, upon sour cherries, the bacilli disappeared in three hours; upon sweet cherries, from three to seven days; strawberries, one day; upon pears, two to five days; upon cucumbers, from five to seven days. Five hours were sufficient for the disappearance of the bacilli from the surface of fresh fruits; on dried fruits, from one to two days. If the surface of the dried fruits was moistened, the time was lengthened from one to seven days before they disappeared. Upon freshly-cut surfaces of sweet Florida oranges and bananas, when

kept at a temperature of 37° C. (99° F.), at the end of twenty-four hours no culture could be obtained.

*Viability in Various Drinks.*—In Pilsener and Munich beer, they disappear in three hours; in white wine, in five minutes; in equal parts of white wine and water, in from ten to fifteen minutes; in red wine, fifteen minutes; in cider, twenty minutes; cold coffee (6-per-cent. infusion), two hours; unsterilized milk, twenty-four hours; in sterilized milk they were present at the end of nine days, and one observer has found them at the end of thirty-three days; in a 2-per-cent. infusion of cold tea they disappear after four days, and in a 3-per-cent. infusion in one day, and a 4-per-cent. infusion in one hour; in a 1- and 2-per-cent. infusion of cocoa, the bacilli were found at the end of seven days; in carbonic water they quickly die, being here killed by the carbonic-acid gas.

*Upon Fish.*—Upon fresh flounder, shell-fish, and carp, after two days they had disappeared;

upon salted and smoked herring, after twenty-four hours; and upon caviar, at the end of forty-eight hours.

*Upon Tobacco.*—Upon moist Havana tobacco they were absent at the end of twenty-four hours; upon quite-dry cigars or slightly-moistened ones, one-half hour to three hours was sufficient for their disappearance; upon a sterilized infusion of tobacco, at the end of ten days the bacilli were still growing, and only at the end of thirty-three days were they found to have disappeared. At the end of five minutes the smoke of one-half a cigar was sufficient to kill all cholera bacilli growing in a bouillon culture, and the same length of time for those growing in saliva.

*Upon Bread and Butter.*—Upon the surface of slices of rye-bread, freely exposed to the air, the bacilli were found after twenty-four hours; when the bread was wrapped in paper, for three days; and if placed under a bell-jar, for seven days. Upon sweet butter they survive a week, and have been found at the end

of thirty-two days; on rancid butter, but a short time.

*Upon Miscellaneous Substances.*—Upon the printed pages of a book they may survive for seventeen hours, and upon writing-paper inclosed in an envelope for twenty-three hours. Upon copper and silver coins they only survived for half an hour. Upon the dry hand for one hour. On dry textile fabrics they die out after four days, and if the fabrics were moist they were found present at the end of twelve days. Upon soiled linen, bedding, or wearing apparel, they can survive over two weeks if these be kept moist. In spring-water they die out in from five to eight days, in well-water in twenty-four hours to six days, and in sterilized water they have been found after three months. In sea-water they retain their vitality for four days; but if this be mixed with sewage they only survive from twenty-four to forty-eight hours.

## THE DISEASE IN HUMAN BEINGS.

*Conditions Necessary for the Development of the Disease in Human Beings* are:—

1. The presence of the cholera bacillus. This is the prime requisite, without which there can be no cholera.

2. The germs must gain an entrance into the human body, and this is known to occur only through the mouth.

3. The condition of the person affected must be such that the germs can grow and multiply in the body.

The first of these propositions, if we admit the causal relation existing between the germ and the disease, needs no further mention than has been previously given.

Let us consider the means of the entrance of the germs into the mouth and intestines. The two avenues by means of which this occurs are the drinking-water and the food.

Instances where people have been attacked by cholera from drinking water from a well contaminated by the excreta of persons dying of cholera are very numerous, and one illustration of this kind will suffice. In London there was a certain well into which the liquid contents of a sewer had been percolating for months. Of the water of this well hundreds of persons had been drinking without obvious injury. At last a case of cholera occurred hard by. The discharges were thrown into a privy which communicated with the sewer, and, indirectly, with the well, whereupon more than five hundred persons, who drank water from that particular well, were attacked with cholera within three days.

The recent epidemic, during 1892, in Hamburg, Koch explains thus: The bacteria in the dejecta of Russian emigrants suffering from cholera were carried, without disinfection, into the waters of the Elbe River and the Harbor of Hamburg; that this water, which is greatly contaminated by sewage, under the influence

of the high temperature prevailing at the time, allowed of the rapid growth and multiplication of the bacteria in the water. A large part of the inhabitants of Hamburg use this water, unfiltered, for drinking purposes, and received their infection in this manner. Other facts which bear upon the origin of this particular epidemic are, that, in the city of Hamburg, where the epidemic was a considerable one, the earliest and most numerous cases occurred in the parts of the city nearest the harbor.

Altona, which is situated a short distance below Hamburg, and whose inhabitants drink the same water, except that it is filtered, had but a few cases, and those were mostly traced to Hamburg. Further, in the barracks of the Seventy-sixth Regiment, where over five hundred men were quartered, and where the drinking-water was pure spring-water, no cases occurred; whilst in the district all about the barracks there were a very large number of cases, and in families whose circumstances permitted of pure drinking-water

there were but a few cases. The bacilli were found, on examination, to be present in the bilge-water of a ship from the harbor of Hamburg, but no report has as yet been seen of the finding of the germs in the river-water.

*The washing of the clothing* of cholera patients, unless proper disinfection has been previously carried out, is another one of the various methods of the entrance of the germ into the mouth (in these cases being carried there by the hands). Instances of this are not lacking. Thus, a naval surgeon, W. G., dies at Toulon, of the cholera; his linen is sent to La Valette, where they refuse to wash it; it is then forwarded to La Farlade, where the cholera has not yet shown itself. The daughter of the washerwoman, who had assisted her mother, is attacked by cholera, and dies. In cases of this kind it is not the washing of the clothes which is dangerous, but the handling of them without previous disinfection.

The question of the introduction of the germ into the digestive tract by means of

contaminated milk is one of very great importance. The bacilli do not live long in milk, but they do live as long as the milk is fit for drinking purposes. In boiled and sterilized milk, which afterward becomes contaminated, the bacilli multiply rapidly, and retain their vitality for a very long period.

Instances of the spread of the disease by milk, which had been diluted at the dairy by water from an infected well, are not lacking. Thus, ten of the crew of the ship *Arden-clutha*, lying in the harbor of Calcutta in 1887, were found to have drank milk obtained from a certain milkman; the rest of the crew either drank no milk or condensed milk. Of these ten, four died of cholera, five had severe diarrhœa, and one, who had drank but a very small quantity of the milk, remained in good health. One case of cholera developed amongst the crew who had not drank of the milk, and this case was the last on board. Investigation showed that the milkman had been adding 25 per cent. of

water to the milk, and that this water was obtained from a tank befouled with the dejecta of a cholera patient.

Similar instances have been traced to eating contaminated fruit. Fresh vegetables, meats, and, in fact, all articles of food, may be the carriers of the germ, and, at the time of an epidemic, these facts should always be borne in mind.

## THE GERM IN THE BODY.

*Conditions Necessary for the Growth and Multiplication of the Germ in the Body.*—The history of different local epidemics proves that all persons exposed to the disease are not necessarily attacked by it, nor equally affected if attacked. The condition allowing of the development of an infectious or contagious disease, after exposure to, or inoculation with, the poison of the disease, in human beings, is called "the predisposition," and persons in this condition are said to be "predisposed" to the disease. That all persons are not equally predisposed is evident when it is remembered that all exposed to any disease are not necessarily attacked by the disease. This predisposition seems to be a varying condition, dependent upon many factors not perfectly understood. In different individuals it is different, and in the same individual it

varies at different times, as has been shown by experiments upon human beings.

The predisposing condition to an attack of cholera seems to be that there shall be some disturbance of the digestive tract departing from the normal, and those affected with diarrhœa, dyspepsia, people who are poorly nourished, people who are dissipated and indulge in excessive eating and drinking, or who lead irregular lives, all seem to be attacked, provided the germ gains entrance into the body.

## THE DISEASE IN EPIDEMIC FORM.

*Conditions favorable to the development of the disease in epidemic form* are a high temperature and conditions of filth and dirt. The overcrowding and the continued neglect of sanitary and hygienic measures are to blame for the continuance of the disease in its endemic home, and thus for its spread to the western worlds in epidemics. Cesspools and all centres of decomposing vegetable and animal matter, pools of stagnant water and water contaminated by sewage, all permit of the continuance of the life and growth of the bacilli, and thus of the further spread of the disease. If the sanitary condition of a place be kept of the highest order, the fears of the development of an epidemic are slight, provided that individual cases, which may occur, are handled with intelligence and care.

# SYMPTOMS.

## Cause of the Symptoms.

The symptoms present in the disease are, primarily, those of a substance acting in an extremely irritant manner upon the digestive tract of the body, producing excessive vomiting and purging, together with the symptoms of an acute intoxication of the entire system. Chemical analysis has revealed the fact that disease-producing bacteria, while growing in different substances, set free chemical organic compounds, which may be separated and isolated from them. These chemical compounds bear the name of "ptomaines" (from the word ptoma, "cadaver"). The ptomaines produced by the growth and multiplication of the cholera bacilli in the digestive tract are the active substances absorbed into the blood, which give rise, directly or indirectly, to all of the symptoms observed in the disease.

Injections of the ptomaines produced by the growth of the cholera bacilli in nutrient culture media produce, when injected into the blood of animals, symptoms similar to those present in cholera in human beings.

### The Symptoms of the First Stage.

They begin in two ways:—

1. The patient is suddenly seized with severe abdominal pain, with vomiting, purging, and cramps. These last but a few hours, when the patient dies or passes on to the second stage of the disease.

2. The patients have a mild diarrhœa, unaccompanied by pain, with the stools large in amount. They lose appetite, suffer from slight nausea and prostration. These symptoms continue two or three days, when they disappear and the patient recovers (these are the so-called cases of "cholera diarrhœa"), or they pass to

### The Second Stage.

In this stage vomiting and purging become very severe, the stools assuming the so-called

"rice-water" character. Food and drink are vomited. There are severe and painful cramps in the abdomen and legs. The face becomes shrunken, pinched, and livid. The temperature of the body falls below the normal. The pulse is rapid and feeble, the voice husky, and the secretion of urine is very much diminished. Prostration is extreme. This stage lasts from two to fifteen hours, when the patient either begins to get better and goes on to recovery (so-called cases of "cholerine") or passes on to the next stage.

### The Stage of Collapse, or Algid Stage.

Here all symptoms continue: the vomiting and purging become less; the pulse is so feeble it cannot be felt; the change in the countenance becomes more marked; the cheeks are wasted and thin; the eyes deeply sunken in the head, with their lids half opened; the nose is pinched and blue, the body covered by cold and clammy sweat, and prostration is extreme; the urine is greatly diminished or

suppressed. Intelligence is retained throughout, but the patients are restless and sleepless, and complain of constant thirst. This stage seldom lasts as long as forty-eight hours, when the patient either dies, gets well, or passes to the next stage.

### The Stage of Reaction, or Typhoid Stage.

In this the purging and vomiting cease, the patient becomes stupid, or there is delirium. The temperature rises, there is more or less fever, and the numerous complications of the disease appear. There may be suppression of the urine from the complicating inflammation of the kidneys; diphtheritic inflammation of the stomach and intestines; abscesses or inflammations of the various parts of the air-passages develop. Few of those who reach this stage recover.

In some rare cases—the so-called "cholera sicca"—the patients die before vomiting and purging occur, passing, within a very short time, into a condition of collapse; being appar-

ently overwhelmed by the virulence of the poison.

THE APPEARANCES FOUND AFTER DEATH.

These vary with the stages of the disease in which the patient dies.

1. *If the patient dies before the typhoid stage*, the temperature of the body may rise after death. Post-mortem rigidity begins early, and is very well marked. On account of the excessive dryness of the body, decomposition occurs late. The face and trunk are greatly emaciated. The countenance is so greatly changed that recognition is oftentimes difficult. The lips and nails are greatly cyanosed. The membranes of the peritoneal, pericardial, and pleural cavities may be coated with fibrin. The blood is thick and dark colored; the lungs are shrunken and pale. The lining membrane of the stomach may be the seat of inflammation. The lining membrane of the small intestine contains too much or too little blood, and that of the large intestine

may be covered by a diphtheritic membrane; the solitary glands of the intestines are swollen, this being more marked in the small than in the large intestine. The kidneys show the changes found in acute inflammation of these organs.

2. *In those who die during the typhoid stage* a somewhat different appearance is found. The cyanosis of the skin is not present; the blood is more fluid; the post-mortem rigidity is less marked, and the muscles contain more moisture than when the patient dies during the other stages. And there may be found the changes characteristic of the various complications.

## Diseases Presenting Symptoms Similar to Asiatic Cholera.

*Cholera nostras* occurs especially in hot weather, in sporadic cases or in small groups of cases. Errors in diet or living are usually assigned as the cause. Here the symptoms are similar to those of cholera; the invasion is sudden, being marked by profuse vomiting and di-

arrhœa. The stools may take on a "rice-water" appearance; there may be severe abdominal pains, cramps in the muscles, prostration, and husky voice. The disease lasts but one or two days, as a rule, and results quickly in recovery, or death may occur amongst those whose general health is depreciated by age, dissipation, insufficient food, or otherwise.

Poisoning by arsenic, corrosive sublimate, vegetable fungi, and decayed meat or fish produces similar clinical pictures, but it is beyond the scope of this book to go into the differential diagnosis of these conditions.

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## THE DIAGNOSIS OF THE DISEASE.

THE diagnosis of the disease is easy during the time an epidemic is raging, or when well-marked cases appear, but different is the question when the disease is threatening to enter a town and suspicious cases occur. The only positive proof of the presence of the disease is the discovery of the bacilli in the dejecta of the affected person, or in the intestinal contents and walls of the dead body, by bacteriological examination. The importance of distinguishing mild cases by this means cannot be too strongly insisted upon.

The method of determining the presence of the bacilli is as follows: A little of the infected material, or a small quantity of the intestinal contents, is inoculated in bouillon and in nutrient gelatin. After twelve hours there is seen to be a thin, wrinkled film growing upon the

surface of the bouillon. A little of this film is then used to start a new culture in bouillon, and a gelatin plate-culture is made from another portion. The remainder of the bouillon culture is used to test for a chemical reaction, which is found present in cultures of the cholera bacilli. This test, discovered simultaneously by two different observers, is as follows: A small quantity of chemically-pure sulphuric acid is added to the bouillon culture; there is soon produced in the solution a reddish-violet or purplish-red color, which becomes more pronounced after half an hour. This is the so-called "cholera-red reaction."

Microscopic examination of the above-mentioned films shows the presence of the cholera bacilli, and an examination of the gelatin plates shows their characteristic manner of growth. When all these tests have been made and their terms complied with, the diagnosis can be made with positiveness at the end of forty-eight to seventy-two hours. If but few bacilli be present in the originally infected material, it may be

necessary to make several successive plantings before a positive conclusion can be arrived at.

### Bacteria Resembling the Cholera Bacillus.

The first of these is the Finkler-Prior bacillus, originally considered by its discoverer to be identical with the cholera bacillus. The two resemble each other under the microscope, but the Finkler bacillus is, as a rule, larger, thicker, and coarser than Koch's.

Another species is the Deneke spirillum, cultivated from old cheese. The differentiation of these three forms may be difficult in stained preparations under the microscope, but is easy when considered from a morphological standpoint, and as regards their behavior in different culture media.

*The Finkler-Prior Bacillus.*—The Finkler-Prior bacillus on nutrient gelatin plates grows with extraordinary rapidity, and coincident with this growth there is a corresponding liquefaction of the gelatin. Under the microscope, the gelatin of the plate being wholly

liquefied, at the end of twelve to twenty-four hours the colonies appear as round, thick, yellowish-brown masses, possessing a fine but uniform granular appearance. In gelatin tubes the difference is still greater. In a growth of the Finkler bacterium four days old the gelatin is widely liquefied along the line of inoculation, and nearly half of the gelatin changed into a turbid gray solution.

The form of the liquefied area is also different, being bag-like rather than funnel-shaped. After a week the contents of the tube is completely liquefied.

*The Deneke Spirillum.*—On gelatin plates the colonies are easily distinguished from those of the Koch bacillus by their sharply-defined circular form and greenish-brown centres, and by their never possessing the uneven granular appearance of the latter. In addition, extensive and early liquefaction of the plates occur, but this does not occur as quickly as in the Finkler-Prior bacillus.

In gelatin tubes the Deneke spirilli develop

along the whole length of the inoculation; liquefaction occurs more rapidly than in the cholera, and less rapidly than in the Finkler-Prior. The bacteria soon settle to the bottom, and at the upper part of the tube there appears a thin, yellowish zone, over which a funnel-shaped depression or air-bubble, larger than that found in the cholera culture, floats.

# PROGNOSIS

The prognosis of the individual cases will depend upon the way the disease begins, to a certain extent upon the previous health and habits of the patient, and also upon the promptness of the beginning of treatment and the skill and care used in carrying out the treatment

If the premonitory diarrhœa can be stopped, the case usually recovers. If a person be in good previous health, the outlook is better than otherwise. In various epidemics the mortality has varied from 16 to 90 per cent. of those attacked by the disease.

The recent experience at Hamburg has shown, that the sooner the person came under the observation of an intelligent physician, the better was the chance of recovery.

# TREATMENT.

THE indications for treatment in the disease are :—

1. To limit the increase of the bacilli in the intestines.

2. To render harmless the poisonous substances formed by them in the intestines, and to expedite the removal of these substances.

3. To dilute the thickened blood, with the hope of avoiding the attendant evil consequences, is to be attempted. In addition to these, the relief of certain symptoms, such as pain, subnormal temperature, weak heart's action, etc., is to be afforded as far as possible by proper measures as they appear.

It was claimed that all of these indications were fulfilled by a line of treatment proposed in 1884, by Cantani, a Neapolitan physician. This treatment consists in the injection into

the bowels of a large amount of warm solution of tannic acid in water, or infusion of chamomile. The solution is made by dissolving 75 to 150 to 300 grains of pure tannic acid in 3 to 4 quarts of water. This solution is injected either alone, or there may be added to it 20 to 30 drops of laudanum, and at times an ounce to an ounce and a half of gum arabic. The temperature of the mixture when administered is between 38° to 40° C. (100° to 104° F.), and the injection is best made slowly by means of a bulbous rubber syringe. The author of the treatment claims that the injected fluid reaches the small intestine, therefore passing the ileo-cæcal valve, thus acting directly at the site of the diseased process. The results claimed by Cantani for this treatment have, however, not been confirmed by the experience in Hamburg during the past summer. Whether it be that the method was improperly used, or that treatment was not begun early enough, or that his results were obtained on patients who were not suffering from cholera, does not as yet seem clear.

*Treatment of the Preliminary Diarrhœa.*—Absolute rest in bed is the first requisite. Then various lines of treatment may be used. The use of dilute sulphuric acid in 10-minim doses, alone or combined with small doses of opium, every hour or two, has proved of service. Narcotizing the patient by too large doses of opium should be avoided on account of the paralysis of the intestinal walls which occurs in this condition, thus favoring the growth of the bacilli in the intestines.

During the first stage the method yielding the best results has been the administration of calomel. This is given in a preliminary dose of from 4 to 8 grains, and afterward in doses of $\frac{1}{3}$ to $\frac{3}{4}$ grain every two or three hours. It is continued through the first stage, and even through the second. The danger of causing mercurial poisoning must be borne in mind during the administration of this drug. For the pains, small hypodermatic injections of morphine are to be used. For the vomiting, small doses of champagne, or brandy and water, with counter-

irritation over the stomach, either alone or combined with the administration of small doses of cocaine, have proved of most service.

*In the Algid Stage.*—The injection of warm saline solutions into the veins is here indicated. For this purpose, 1 quart of a sterilized $\frac{6}{10}$ of 1-per-cent. solution of salt is the easiest made and serves every purpose. The vein selected is generally the median cephalic, or another one of the superficial veins of the arm. Hayem's solution for the same purpose is made by adding 60 grains of salt and 150 grains of pure sulphate of soda to 1 quart of distilled water. The mixture is sterilized, and filtered through sterilized filter-paper. The amount of fluid to be used at each injection is about 1 quart. The temperature of it should be between 38° to 40° C. (100° to 104° F.).

Cantani proposed the hypodermatic injection of a solution composed of 60 grains of salt, 45 grains of carbonate of soda, and 1 quart of sterilized distilled water. This amount is injected under the skin, into the subcutaneous

tissue of the body, in two different places,—that is, 1 pint into each. The sites of injection chosen are either the region of the buttocks, the interscapular region, the groins, or the ileo-costal regions. The latter Cantani prefers. This procedure is the so-called "hypodermato-clysis."

Samuels has modified it by using continuous injections, and claims for them more favorable results. All of these solutions are used with the object of supplying fluid to the blood to replace that lost by the excessive vomiting and purging. The immediate effects of the infusions are well marked, but unfortunately not lasting, and their repetition is necessary after a few hours. Not over three or four per day can be given, and they should be begun before the patients are so far advanced in the disease that they are unable to respond to the treatment.

During this stage the subnormal temperature calls for treatment, and this is met either by the use of hot bottles about the patient, or

by putting the patient into a hot bath of a temperature between 100° to 105° F. for a short period of time (fifteen to thirty minutes). The same end is said to be accomplished by means of a hot-air bath, but the reports of this procedure have not been favorable.

For the saline infusion into the veins, a glass reservoir holding a quart, a flexible rubber tube, and a needle trocar, for introduction into the veins, are necessary. For hypodermatoclysis the needle trocar is replaced by a large-sized hypodermatic needle. This should be introduced some little distance under the skin, into the subcutaneous tissue, and gentle massage over the site of the injection is to be practiced whilst it is being given, in order to facilitate diffusion and absorption of the injected fluid. This method is much to be preferred for the general practitioner, but has not yielded as good results as the intra-venous infusion.

The necessary amount of pressure for both the hypodermatoclysis and venous infusion is obtained by elevating the vessels containing

the injection fluids. The time used for each injection should not be less than fifteen minutes, and the temperature of the fluid is to be maintained by placing the glass reservoir in another vessel containing hot water.

All vessels, instruments, and solutions used should be thoroughly sterilized by boiling before using. The importance of this is such that it is better not to attempt to make use of this line of treatment unless thorough cleanliness and sterilization of the instruments and solutions can be obtained.

The feeding of the patients during the attack is not very satisfactory, and the physician should rest content to give small amounts of milk, or milk and carbonic water, at frequent intervals.

*In the Typhoid Stage.*—In the typhoid stage the different complications must be treated symptomatically as they arise, but treatment is unsatisfactory, most patients dying in this stage, no matter what treatment is used.

In patients who are recovering and have

recovered, the importance of *disinfecting the stools after the diarrhœa has ceased* must not be forgotten, and patients should be kept under observation and movements disinfected for at least ten days after recovery.

# PREVENTION.

Possessing, as we do, the knowledge of the cause of Asiatic cholera, and the circumstances under which the germ survives and flourishes, and the fact that the contagion is only conveyed to the body in certain ways, it would seem to be an easy problem to prevent its occurrence in epidemics and subsequent spread to other parts of the world, with the sacrifice of such an enormous number of human lives. Theoretically, it is easy; but the great mass of mankind are of such a low order of intelligence, and are governed so much by prejudice, superstition, or inherited ideas, that knowledge which explains the why and wherefore of diseases which in olden times were, and still to a large extent are, looked upon as visitations of the Almighty is received with incredulity or indifference.

The few simple facts necessary to a complete understanding of the disease under consideration are so easily comprehended, and the conclusions to be drawn from them are so self-evident, that it is but a matter of astonishment and wonder that governments should hesitate for a moment as to what should be done looking toward the disappearance of cholera from its original home, and its spread westward. Yet the English government has been unwilling to carry out the measures advocated by its sanitarians for the control of the disease in India. To England principally, if not wholly, is due the blame for the last epidemic, which at present is threatening to enter our own country.

### Sanitary and Hygienic Measures.

Could the sanitary condition of a city or town be kept in the best of order, there would be but little danger that an epidemic could occur, even though the germs should gain entrance into the place; and in the prevention of cholera, as in the prevention of all the germ diseases, the

first duty of the state to its inhabitants is that it shall not permit conditions favoring the continuance and spread of the disease to exist. One word will express all that is necessary, and that word is *Cleanliness.*

Of the utmost importance is the proper guarding and protection of the water-supply. Formulate and promulgate rules as we will, the fact remains that the larger part of the inhabitants of cities, towns, and villages will not and often can not boil water used for drinking. In Hamburg, during August, 1892, when the first cases of cholera occurred, there were 85 cases reported on the 20th of the month; on the 24th there were 367, and on the 27th 1103. In no other way can this rapid explosive outbreak be explained except by contamination of the water-supply.

Persons who use water for drinking purposes from wells, cisterns, or small streams should take particular care that it be boiled, as the means of contamination of these sources are so varied, and at times situated at such a distance,

that a false sense of security arises, which often leads only to disaster.

Next in importance to the preservation of the purity of the water-supply is the prompt identification of the disease, and then its prompt handling to prevent its further spread.

If suspected cases appear when an epidemic is threatening, all persons should be immediately excluded from the rooms where these occur, and the patients removed as soon as possible to a proper hospital for treatment. The bedding and clothing, and all upholstered furniture of the room, together with carpets and matting, should be burned, the owner being recompensed by the authorities.* All utensils used by the patients should be boiled in soda solution one-half of an hour, or be disinfected by milk of lime, and the room should be disinfected, as hereafter mentioned, by sulphur.

If, in spite of precautions which have been

* If the knowledge be disseminated amongst the inhabitants, that receipts will be given and proper recompense made for all articles destroyed, the early report of cases to the authorities will be greatly facilitated.

taken, or if after their neglect, an epidemic arise, it is the duty of the authorities to furnish free medical attendance in the crowded districts, and persons attacked should be treated in hospitals, or in buildings taken for this purpose, in the parts of the city where the epidemic is prevailing. All cases should be removed to these hospitals, the bedding either burned or properly disinfected, the rooms disinfected, and all who may have come in contact with the patient be regarded as "suspects," and kept under proper observation by an official of the health authorities for at least five days.

In addition to free medical attendance, a corps of trained disinfectors should follow the removal of the patients; and the necessity of erecting in different parts of the city temporary disinfecting plants would arise, in order that proper disposition might be made of infected material and unnecessary destruction of property be avoided.

*Precautions to be Taken Regarding Railway Carriages.*—Whilst the disease is prevailing,

the dejecta of passengers should not be permitted to be thrown on the road-bed of the railway without previous disinfection, and this is most quickly accomplished by carbolic-acid solution. It would become necessary either to alter the existing style of closets or to provide proper utensils for the reception and disinfection of dejecta.

### Prevention of the Disease in Individuals.

Were it possible for us to keep our digestion in perfect order, it is probable that the acid present in the gastric juice would be a sufficient safeguard at all times against cholera, for there is but little doubt that the smaller proportion of those who swallow the bacilli become affected with the disease. Inasmuch as this is an impossible thing, our efforts must be directed toward keeping the general health of the best, and to avoiding carrying the bacilli to the mouth, or destroying them before they reach there.

The mode of living should be regulated; all

excesses in eating or drinking, late hours and dissipation, excessive fatigue and insufficient sleep should be strenuously avoided; overheating by exposure to the sun, or by working in close, ill-ventilated rooms, where the temperature is continuously high, should be guarded against. The drinking of large quantities of water between meals, and of spirits at any time, must not be indulged in.

Only water which has been boiled or distilled should be used for drinking purposes. Water which has been boiled for five minutes is absolutely safe, if it be not afterward infected or polluted. In order to prevent this, it is preferable that the boiling should be done just before using. Milk should be either boiled or sterilized before using.

It may have been observed by the reader that nothing has been said regarding prevention of the disease by the so-called "inoculation" or vaccination. Numerous observers are still working upon the subject, and there is every probability that their efforts will sooner

or later be crowned with success, but as yet the process has not proved of any value in the human subject.

The use of fruits should be avoided on account of their tendency to produce diarrhœa, and in an uncooked condition they may act as carriers of the germs of the disease. If eaten at all, they should be clean and fresh and properly cooked. Eating uncooked vegetables or meats should be forbidden. All cooking utensils and table-ware should be washed in boiling water. Fruit, and all articles of food, especially butter, milk, and sugar, should be kept covered or in closed spaces to protect them from soiling by flies, not only for the sake of cleanliness, but also to exclude infection from this source, as it has been found that the bacilli are present in the intestines and in the excrement of flies that have fed on material containing the bacilli.

The care of the skin should be attended to, and daily bathing in cold water, with thorough drying of the body afterward, should be practiced. Children are to be bathed daily in tepid water,

and should wear thin flannel next to the skin in order to prevent chilling of the surface; with this object in view a flannel abdominal band should be worn at night.

The hygienic conditions around dwelling-houses and in rooms where cooking is done should be strictly looked after. All vegetable and animal refuse of the household should be immediately removed before putrefaction sets in. The closets and drains should not be permitted to become stopped, but should be flushed daily with plenty of pure water, and once daily there should be emptied into the closets and sinks a gallon or more of chloride-of-lime solution, which is easily made and cheap. In the crowded districts of the city this should be provided by the health authorities free, and people should be encouraged to make free use of it by having it easy of access and in sufficient quantities. Cess-pools and privies should be disinfected daily by the addition of freshly-prepared milk of lime.

All disturbances of the digestion should be

prevented by moderation in eating and drinking, and should be corrected by medical advice if they arise. All who suffer from chronic stomach or intestinal disturbances should take especial care that their food be properly cooked and drinking-water boiled before taking. Upon the appearance of the slightest symptoms of diarrhœa the patient should go to bed and send for his physician, and not be content with the idea that "it will soon pass away." It is best to refrain, under these circumstances, from taking any food or drink into the stomach for from twelve to twenty-four hours. Free medical advice should be furnished at all hours in the more crowded and tenement-house districts by the authorities, and the inhabitants are to be made thoroughly familiar with the importance of seeking medical advice early.

### Precautions to be Used by Those who Come in Contact with the Sick.

The infectious agent is present only in the dejecta and vomited matter of those suffering

from the disease, and only by the soiling of different objects, or the person or the clothing of those about a patient, can the disease be spread. The experience of all epidemics has shown that it is rare for nurses, doctors, and attendants to be attacked by cholera, as they are in the habit of making use of simple rules which can be carried out by all, if the principles underlying them be understood.

As has been before said, the carrying of bacilli to the mouth by means of the hands is one of the commonest avenues of infection, and probably, next to the infection by water, is the commonest. It is almost impossible for those around the sick—who handle the discharges, the soiled linen, the bedding, the dishes, and utensils—to avoid soiling their hands at some time or other; and it should always be the rule to thoroughly wash the hands first with chloride-of-lime solution, then with soap and water, scrubbing with a nail-brush, and after this has been done to put them into a solution of 1-to-500 corrosive sublimate, and following this with a

weak solution (2 per cent.) of hydrochloric acid.

These precautions should be taken after handling any object which may be infectious,—clothing, bedding, the patient, or any of the utensils used by the patient.

*The knowledge that it is only the discharges and vomited matter that are the source of the contagion, and that in no other way than by the entrance of the germ into the mouth can the disease be conveyed from one person to another, and that proper and thorough disinfection of these discharges is the only way that the further spread of the disease can be stopped, should be so effectually disseminated that a condition of panic among the inhabitants of a place could not develop.*

### Disposition of the Dead.

The bodies of those dying of cholera are to be immediately wrapped in clothes soaked in the corrosive-sublimate or carbolic-acid solution and cremated, if possible; if this is impossible, they should be buried as soon as circumstances

permit, and the place of burial should be one where contamination of the water used for household purposes is impossible.

### Transportation of the Sick.

The sick are to be transported in wagons whose interiors are painted, that they may be easily cleansed by disinfectant solutions after the transportation of each patient. If carried on stretchers, these should be of stout canvas, and be soaked in an appropriate solution each time after using. The disinfection after each time of using is rendered necessary by the fact that during the time epidemics are prevailing one-third of the patients brought to the hospitals with the diagnosis of cholera are found to be suffering from other diseases, and, if this precaution is not taken, unnecessary exposure to the disease takes place.

Under no circumstances are patients to be carried in upholstered conveyances.

# METHOD OF HANDLING AN OUTBREAK OF CHOLERA ON SHIPBOARD.

THE experience of the United States has not been singular in the evidence that has been afforded that, in the great majority of cases, the introduction of cholera has been the consequence of the inefficient administration of the ship's surgeon. But, however great the excuse may have been in the past, there is but little reason to-day for any delinquency on the part of that official, in view of our better knowledge of the cause of the disease and of the measures best calculated to insure its control.

The health officer of the port of New York said, in his annual reports for 1890 and 1891, "The carelessness or ignorance of medical officers of passenger steam-ships continues to give rise to endless anxiety." As the compensation of these officials varies from twenty to fifty

dollars per month, it may be imagined that it is difficult to obtain medical men of high standing and with good professional qualifications who are willing to retain positions in which their dignity and self-respect are ignored, and in which their meagre income is enhanced by the gratuities of passengers tendered to them as it is to the stewards. Furthermore, no code has been formulated for their guidance in case of such emergency as the outbreak of cholera among the passengers, and the measures that are adopted vary with the attainments of the surgeon.

In the case of cholera, the first essential for the preservation of the health of the passengers on an ocean steam-ship would be to avoid taking passengers that came from an infected district. A clause could be inserted in all contracts for passage providing that, in the event of the appearance of an epidemic disease in the locality where the intending passenger resided, the contract would be null and void if the steam-ship companies so de-

sired. That such a clause is necessary is apparent when it is recalled that several steam-ship companies claimed that their contracts with immigrants necessitated their furnishing transportation after the President had proclaimed a twenty-day detention of all immigrants, in consequence of the cholera in Europe in 1892.

The ship's surgeon and a local sanitary inspector employed by the steam-ship company should inspect each of the emigrants before they are allowed to go on board of the vessel. Necessarily, any one suffering from any of the early symptoms of cholera would be detained and isolated for observation.

During the voyage it should be the duty of the surgeon to make the rounds of the emigrants' quarters each morning and evening; and this daily inspection should include all water-closets, urinals, and bath-rooms, attention being particularly given to their ventilation and disinfection. In case any of the immigrants came from a cholera-infected re-

gion, or in the event of that disease appearing among the passengers or crew, the surgeon should see each individual once or twice daily, as circumstances may indicate.

On the appearance of cholera among the passengers—and recent experience has shown that those in the steerage are most likely to develop or to be the bearers of that disease—the person affected should be isolated at once in the ship's hospital, and be there kept in charge by an attendant, whose sole duty should be to look after the sick. The bedding the person used in the steerage should be burned in the ship's furnaces, and the bunk occupied, as well as those adjoining it, should be disinfected by scrubbing with a solution of bichloride of mercury (1 to 500), and the walls and wood-work of the apartment afterward painted or whitewashed.

The clothing worn by the patient, as well as any belonging to him contained in boxes or trunks in the hold, should be, on the first bright day, brought to an isolated part of the

deck, and there kept exposed to the sun and air for some hours. Any soiled clothing contained in the package should be immersed in a cask of boiling water, or steamed in a steam-box, if there is one; any article of food which may have been concealed should be thrown overboard.

The surgeon, in visiting the patient, should don a rubber suit or a long linen duster, that should be exposed to the sun and air after each visit. He should be scrupulously careful regarding the disinfection of the excreta and of his hands, and should see, as well, that the attendant was equally careful in this latter particular.

If there was any reason to suspect the food or water-supply of the vessel, no uncooked food should be issued and all the drinking-water should be boiled. If the ship's condensers have sufficient capacity, the water-tanks should be separately emptied, in order that they might be steamed under pressure by a temporary pipe-connection with the boilers, and then filled

with the condensed water. The application of this latter procedure early in the voyage would have prevented most, if not all, of the cholera cases that developed at the New York quarantine in 1892 among the passengers and crew of the steam-ships from Hamburg.

The addition to the usual ration issued the emigrants of a daily ration of some light wine to be mixed with the drinking-water would be an advisable precaution, as experiments have shown that the cholera spirillum lives but a short time in a mixture of even equal parts of wine and water.

If several cases of cholera successively appear in any compartment of the vessel, the occupants thereof should be made to go on deck; at the first opportunity the compartments should be closed as thoroughly as possible. If the vessel is a steam-ship, it should be stopped so as to turn a full head of steam into the compartment for some hours. Then, with no other openings of the compartment except to permit the entrance of a machinist

to make the pipe-connections that may be necessary, steam heat should be turned on in the pipes ordinarily used for heating the compartment, so that the moisture of the condensed steam might be dried and the compartment be made habitable.

More than two-score years ago it was shown that this procedure was quite feasible in a naval vessel with the limited facilities therein existing, and that it effectually exterminated yellow fever, a disease that is much more infectious and more resistant than is cholera. With the modern appliances in a passenger steam-ship the entire plan here outlined could be completed in a day. The liberal use of a strong solution of lye or of quicklime in the infected apartment should supplement the steaming.

In case the vessel is not a steam-ship, the compartment should be disinfected by the same methods that, as has been elsewhere indicated, should be employed for the disinfection of a room.

With the disinfection of the water- and food-supply, and of the part of the vessel in which the disease first appeared, the only remaining nidus for disease would be in the passengers themselves; and, by the daily muster, their condition could be carefully supervised, while isolation could be practiced in the case of any suspected person. They should be detailed in sections for baths,—the men under the supervision of the steward, the women under the stewardess,—and facilities should be afforded them for washing soiled clothes that may be contained in their baggage.

Self-evident as many of these measures may appear, it is the failure to apply them that has rendered quarantine an imperative necessity, while the omission of perhaps a single feature will render nugatory all else that may be done.

The ship's passengers and crew are a community, of which the surgeon is the health officer; he may isolate and disinfect, supervise absolutely the food- and water- supply, and, in a limited area, exercise an authority far greater

than has sufficed to enable health officers ashore to stamp out infectious or contagious diseases that threatened the welfare of the community for which they were responsible.

While it is not intended to underrate the importance of vigilance and caution, attention is called to the facts that a recent writer has published, namely: That it is unnecessary to deluge a whole ship with a solution of corrosive sublimate because one or more cases of cholera have appeared in the steerage, particularly in view of the fact that the cholera spirillum only survives a few hours when freely exposed to light and dry air. It is unnecessary to blister the paint in the cabins and injure the dry and clean curtains, stuffed furniture, etc., when no cases of cholera have occurred in that part of the ship.

# QUARANTINE.

It is unimportant whether the term "quarantine" or "maritime sanitation" be used to describe the methods that are employed at a port to insure the good health of the passengers and the innocuous character of the cargo of a vessel that desires to land. The end in view is, that nothing detrimental to the sanitary welfare of the inhabitants of that port should be introduced; and the problem that a port health officer has to solve is how this end may be best attained, conserving the sanitary interests of the community while avoiding needless and injurious restrictions upon commerce.

That the quarantine officer may accomplish these ends, it is necessary that he should have a certain "plant" or establishment that should consist of:—

1. A properly-isolated and arranged hospital, equipped with necessary instruments for

bacteriological examination and for the treatment of the patients, and officered by a competent staff of physicians and nurses. The arrangement of the hospital should include the factors of ventilation, heating, lighting, sewerage, and water-supply. Connected with the hospital there should be suitable furnaces for burning infected articles and excreta, a crematory for burning bodies, and a steam-laundry for affording a plentiful supply of clean clothing.

2. A detention-building, provided with a steam-laundry, kitchen, bath-rooms, etc., etc., in which certain persons that had been exposed to cholera might reside, while under observation, for a term covering the period of incubation of the disease.

3. A disinfecting-chamber in which suspected articles could be subjected to the action of steam under pressure, and a capacious boiler in which infected articles could be boiled.

4. A properly-trained disinfecting corps.

5. Suitable vessels for (*a*) transporting the

sick to the hospital, (*b*) transporting the well to the detention-building, (*c*) for patrol and message service, and (*d*) a vessel having suitable apparatus for either steam or sulphur-dioxide disinfection, or both.

6. Buildings for the accommodation of the quarantine officer and his staff of subordinates.

With these necessary buildings and attendants the health officer should be able to undertake a campaign against any pestilential disease that may be brought to the port. But, in order to wage his war intelligently, it is absolutely essential that he should supplement a generous information regarding, and experience with, epidemic diseases with considerable executive ability. His plans of administration must be formulated in preparations for any emergencies that may arise; for nothing but disaster, needless suffering, and loss will result if vague and ill-considered measures are adopted.

On the arrival of a vessel on which cholera has occurred the steps taken by the health officer must largely depend upon the course

that has been pursued by the ship's surgeon. If that officer has followed such a plan as has been outlined in the preceding chapter, there will be but little for the health officer to do except to supplement it with such precautionary measures as may be deemed desirable.

If there is cholera on the vessel when it arrives, the sick should be at once transferred from the ship to the quarantine hospital. The bedding that was used on the ship should be burned. The ship's hospital—or the steerage compartment, if the number of cases was so great that the hospital could not accommodate all the patients—should be steamed from the ship's boilers, or from the quarantine disinfecting tug. By using suitably-situated electric thermometers, it will be possible for the physicians in charge of the disinfection to determine the length of time that the steaming should be continued. After the steaming, the disinfecting corps should be set at work in the compartment, in accordance with the measures elsewhere indicated.

If the quarantine officer has reason to suspect the water-supply of the vessel, he should have the water-tanks emptied at once, washed out with an acid solution, steamed, and then refilled with water brought from some supply ashore. Similarly, if there is reason to suspect the food-supply of the vessel, fresh rations should be furnished from ashore.

The passengers among whom the cholera occurred should, with their baggage, be transferred to the detention-building during the time that the disinfection is being carried out on board the ship. They should be required, under the supervision of male and female superintendents, to bathe and clothe themselves in clean clothing taken from their luggage,—and the latter should be carefully inspected by the physician in charge of the detention-building and the baggage disinfection.

Regarding nothing has there been more injudicious zeal displayed than in the disinfection of luggage. While there are many authenticated instances of wearing-apparel

serving as carriers of the bacilli, this precedent is not sufficient excuse for the wholesale disinfection by washing or steaming of all the effects of all the immigrants or other passengers on a vessel on which cholera has occurred. Due consideration must be given to the facts regarding the locality from which the immigrants come, and whether his baggage was exposed to extraneous infection during its transit to the port of arrival.

All baggage of immigrants coming from regions that are known to be or suspected of being infected should be inspected and properly disinfected. It has been shown that articles that may be injured by being exposed to steam may be efficaciously disinfected by being exposed to the sunlight and air. In fact, the experiments demonstrated that there was nothing more noxious for the cholera spirillum than light and dry air, and that all classes of articles may be disinfected, as far as the organism of cholera is concerned, by exposure thereto.

Whatever methods are adopted,—steaming,

boiling, or airing,—the procedure should be carried into immediate effect, and, as fast as the immigrants and their baggage have been disinfected, they should be put into groups according to the accommodations at hand. These groups should be separated from one another, and at no time during the detention period should they be permitted to mingle with one another. If at the end of five days no cases have developed, they may be permitted to land. If cases develop amongst any of the groups, those belonging to this group should be kept five days after the development of the last case. If there be not sufficient facilities for isolating the passengers into groups, they should be returned to the ship as fast as the different lots with their luggage are disinfected. The entire procedure could be accomplished, even in the case of a large vessel, within fourteen hours, where a suitable quarantine plant existed, and the re-transfer of cleansed passengers and cleaned luggage to a clean ship would obviate the

necessity of creating possibly new foci for the disease in a quarantine camp.

These measures have disinfected the ship, or at least that part of it that was likely to be infected; they have insured a proper food- and water- supply; they have disinfected the immigrant and his baggage, so that the person of the immigrant is the only possible remaining source of infection.

The statistics of the Chief of the Bureau of Statistics show that the immigration into the United States is principally through the ports of New York, Baltimore, Boston, Philadelphia, San Francisco, New Orleans, Portland (Me.), Key West, New Bedford, Willamette, and Galveston. So it is necessary that these ports should be properly equipped with quarantine facilities commensurate to the demand that may be made upon them.

The expression of opinion by the International Sanitary Conference in Rome, in 1885, that the disinfection of merchandise and of the mails is unnecessary, relieves commercial inter-

ests of the necessity of bearing the heavy expense of lightering the cargo of a vessel and of disinfecting merchandise that may be received by being subjected to that process.

It will be seen that it is believed—and bacteriological experiments as well as recorded facts sustain the position—that vigorous means of local disinfection and prophylaxis following the removal of cholera patients from a ship would control and prevent the recurrence of the disease without the removal of the passengers to camps where they might be isolated in groups. There is at present no quarantine establishment in the world at a port having a commerce as large as that of New York, for example, that is arranged on so extensive a plan that it would be feasible to isolate the passengers in groups for observation during the period of incubation.

Nor does the knowledge that we possess regarding the cause of cholera and the means by which it may be exterminated justify the construction of so elaborate an establishment.

# DISINFECTION.

THE object of disinfection in disease is to kill all germs which cause the infectious diseases, in order to prevent their further spread. This is accomplished by chemical agents or by various means which have been found to serve the same purpose

A disinfectant must be distinguished from a deodorant, by which term is only meant a substance capable of destroying a noxious odor; and from an antiseptic, which simply prevents germs growing.

The agents used for disinfection are high degrees of heat, applied either dry as hot-air or moist by steam, or by boiling. Sunlight, fresh air, and drying in the air are also other disinfecting agents, but are uncertain or unreliable in action, and cannot always be applied when and where wanted.

The chemical agents most commonly used are solutions of *corrosive sublimate*, *carbolic acid*, *chloride of lime*, and also *sulphur-dioxide gas*, whose action is exerted as *sulphurous acid.*

For disinfectants to fulfill the object desired, they must come into immediate contact with the germs of the disease, and must be of such strength as is known to destroy them.

To Prepare the Different Solutions.

1. *Corrosive-Sublimate Solution* (Bichloride Solution).—Dissolve 60 grains of pulverized corrosive sublimate and 2 tablespoonfuls of common salt in 1 gallon of hot water. This makes a solution of the strength of 1 to 1000.

2. *Carbolic-Acid Solution.*—Dissolve 6 ounces of pure carbolic acid in 1 gallon of hot water. Crude commercial acid may be used if an equal volume of concentrated sulphuric acid be added to it. Twelve ounces of this mixture should be dissolved in 1 gallon of hot water and the undissolved parts or oily consistency be removed

by filtration. These make a solution of the strength of 1 to 20.

3. *Milk-of-Lime Solution.*—Milk-of-lime solution is made by adding 1 quart of freshly-slacked lime to 4 quarts of water. Lime is slacked by adding a small quantity of water to quicklime; the lime becomes hot, crumbles, and when the slacking is completed a white powder results. The powder is used to make milk of lime. Air-slacked lime is useless as a disinfectant.

4. *Chloride-of-Lime Solution.*—Add 6 ounces of fresh chloride of lime to 1 gallon of water. The powdered chloride of lime should be kept in a tight vessel and the solution prepared daily.

*Sulphur-Dioxide Gas.*—The sulphur-dioxide gas is obtained by burning sulphur in the air. To be effective for disinfection, there should be burned 3 pounds to every 1000 cubic feet of air-space.

*Disinfection of the Discharges and Vomited Matter.*—They should be received in a vessel

made of china, glass, or granite ware. Into this vessel there should be put a quantity of milk of lime equal in amount to the discharges to be disinfected, and there should be an intimate mixture of the two substances. This mixture must be permitted to stand for one hour. At the end of this time, when disinfection is completed, it may be thrown away. Cloths soiled by expectorated or vomited matter should be burned.

Chloride of lime may also be used to disinfect the stools. For this purpose an equal amount of the solution should be added to the material to be disinfected, and be allowed to stand for half an hour, after which disinfection is completed and the mixture may be removed.

*Disinfection of the Hands and Other Parts of the Body which have come in Contact with Infected Articles.*—They are to be thoroughly washed with chloride-of-lime solution, making use of a nail-brush for the purpose, after which they may be washed with soap and water and

put into a weak solution (2 per cent.) of dilute muriatic acid. The nail-brush should be kept in bichloride solution when not in use. Bed- and body-linen, as well as all other wash-goods, are to be immediately placed in bichloride or carbolic-acid solution, and kept in these solutions for at least twelve hours, after which they are to be rinsed in water and washed as usual. If it is impossible to put them immediately into one of these solutions, they should be put into a bag moistened by either one of the solutions and removed for further disinfection.

The hands are to be thoroughly disinfected after handling these objects. Wash-goods may be absolutely disinfected by being put into water containing washing-soda in the proportion of a tablespoonful to 2 gallons, and boiled for one-half hour. The boiling must be continuous, and is best done in a closed vessel. After the boiling is completed the goods may be washed as usual. Having disinfected stools, vomited matter, and linen, we can proceed to the—

*Disinfection of a Room and its Contents.*— Hair mattresses and clothing which cannot be boiled should be placed in a bag or wrapped in cloths moistened with one of the foregoing disinfectants and removed for steam disinfection. If it is impossible to send these goods to a suitable steam disinfecting-plant, the mattresses are to be ripped open and their contents removed, and both contents and ticking are to be soaked in a carbolic-acid solution for one-half hour and then dried. Woolen clothing can be similarly treated without damage, or may be hung in the sun, or exposed to the air under cover to protect them from the rain, for six days, until thoroughly dry.

Leather goods are to be thoroughly wiped with the carbolic-acid solution. Wood and metal parts of furniture and the wood-work of the room are to be thoroughly wiped with cloths wet in the carbolic acid or bichloride solutions, and the cloths so used must be burned.

Upholstered furniture is to be wrapped in

cloths moistened by carbolic acid or corrosive sublimate and removed. If of little value, it had better be burned. It may be disinfected by soaking in either one of these solutions for two hours, or by exposing it to the sun or drying influence of the air for the same length of time as recommended for hair mattresses. Having disinfected and removed the contents of the room, we proceed to the treatment of the walls and floor.

The walls of the room must be washed with a disinfecting solution or whitewashed with the milk-of-lime solution, which may be removed by washing at the end of two hours. The floor of the room should receive the same treatment as the walls. After these measures have been carried out, the windows and doors are to be closed and sealed, and sulphur is to be burned in the room in the proportion of three pounds to every thousand cubic feet of air-space. The sulphur should be placed in a capacious metal vessel, a small amount of alcohol poured over it, and this should then be ignited.

Portions of area-ways, hall-ways, or gutters, soiled by suspicious discharges, are to be disinfected by pouring copious amounts of milk of lime or carbolic-acid solution over them. Public closets are to be disinfected at least twice daily by adding chloride of lime or carbolic-acid solution, where there is running water, or milk of lime under other circumstances; at least two gallons of the solution should be used on each occasion. Closet-seats should be washed at least twice daily by carbolic-acid solution, and following this with soft soap and a scrubbing-brush.

If it be impossible to thoroughly disinfect objects as above described, it is better to burn all that may be considered suspicious. Imperfect disinfection is worse than none, on account of the feeling of false security it gives. Thorough cleanliness is to be preferred to imperfect or careless disinfection.

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